

SOIL AND VEGETATION STUDIES AT SOUTH BALAGHAT, MADHYA PRADESH IN A MIXED PLANTATION FOREST AREA

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Abstract: A mixed plantation area at Varseoni Range of Balaghat district were studied in terms of soil profile, soil analysis, plant biomass, plant part analysis and vegetation study. In a comparative tree study of quantification of percentage of elements in different plant body parts, it was found that Nitrogen was in highest amount in *Emblica officinalis* leaf and lowest in *Acacia catechu* leaf; Phosphorus found highest in *Gmelina arborea* stem and lowest in *Lagerstroemia parviflora* branch; Potassium highest in *Emblica officinalis* leaf and lowest in *Acacia catechu* branch; Sodium highest in *Dendrocalamus strictus* leaf while lowest in *Eucalyptus tereticornis* branch; Calcium highest in *Acacia catechu* leaf while lowest in *Acacia auriculiformis* stem; Magnesium highest in *Cleistanthus collinus* branch while lowest in *Acacia auriculiformis* branch. Regarding the biomass study, the height and collar girth increase most in *Cleistanthus collinus*; height grows least in *Lagerstroemia parviflora*, and burring the case of bamboos, collar girth grows least in *Eucalyptus tereticornis*. The wet weight increases most in *Emblica officinalis* and least in *Eucalyptus tereticornis*.

Keywords: Soil, Vegetation, Mixed Plantation.

Introduction

A mixed plantation area under compartment numbers 504, 505 and 506 at District Balaghat (South Balaghat Division) Varseoni Range, were studied in terms of soil profile, soil analysis, plant biomass, plant part analysis and vegetation study. The phyto-sociological study was made by quadrat method. Three quadrates of the size of 20m x 20m were fixed for the study of the tree species and within these quadrates of 5m x 5m were laid out for shrubs and within these quadrates were laid out 1m x 1m for herbs and grasses. The number and type of each species occurring in the quadrates were recorded. The basal area of each species was calculated on the basis of relative density, relative frequency and relative dominance (Misra, 1968). The tree species diversity was determined by using Shannon-Wiener information function (H) (Shannon-Wiener, 1963).

$$H = - \sum_{i=1}^s [(N_i/N) \log_2 (N_i/N)]$$

Where N_i = Importance value of species i and N = Total of importance value of all species.

Concentration of dominance (C_d) was measured by Simpson's index (Simpson, 1949)

$$C = \sum_{i=1}^s (N_i/N)^2$$

Species diversity (Shannon-Wiener index) was calculated following Shannon and Wiener (1963).

Description of Compartments

Three compartments, viz. 504, 505 and 506 were exhaustively studied as stated before. The tree species were considered for this study, which existed as plantation. In fact, in this mixed plantation area, naturally regenerated species were occurring in all the compartments, and most of the species were found present in all those compartments (Table 1).

Table 1. Description of compartments

Compartment No.	504	505	506
Year of plantation	1990	1988	1997
Range	Varseoni	Varseoni	Varseoni
Division	South Balaghat	South Balaghat	South Balaghat
Area	52 Ha	38.68 Ha	116.87
Sheet no.	64C/1, A2	64C/1, A2	64C/1, A2
Aspect	South	South	South
Gradient	General	General	General
Configuration	Plain	Plain to undulating	Plain
Altitude	1000'	1000'	1000'
Rock	Gneiss	Gneiss	Gneiss
Soil	Sandy loam	Sandy loam	Sandy loam
Slope	Gentle	Gentle	Gentle
Density	0.3 to 0.4	0.4 to 0.5	0.5 to 0.6
Forest type	Dry deciduous mixed forest	Dry deciduous miscellaneous forest	Dry deciduous mixed forest
Quality	IV type	IV type	IV type
Over wood	<i>Acacia catechu</i> (plantation),	<i>Lagerstroemia parviflora</i> , <i>Butea</i>	<i>Terminalia tomentosa</i> ,

	<i>Dendrocalamus strictus</i> (plantation), <i>Emblica officinalis</i> (plantation) and <i>Cleistanthus collinus</i> .	<i>monosperma</i> , <i>Acacia auriculiformis</i> (plantation), <i>Dyospyron melanoxylon</i> , <i>Eucalyptus tereticornis</i> (plantation), <i>Gmelina arborea</i> (Plantation).	<i>Lagerstroemia parviflora</i> (plantation), <i>Pterocarpus marsupium</i> , <i>Terminalia chebula</i> , <i>Anogeissus latifolia</i> , <i>Edina cardifolia</i> , <i>Butea monosperma</i> , <i>Dyospyron melanoxylon</i> , <i>Casia fistula</i> , <i>Cleistanthus collinus</i> (plantation).
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Description of the soil profile

Profile No. 1, Compartment No. 504 (*Dendrocalamus strictus*, *Emblica officinalis*, *Acacia catechu* plantation)

<u>Horizon</u>	<u>Depth</u>	<u>Characteristics</u>
A1	0 – 19 cm	Dark yellowish brown (10 YR 3/4), sandy loam, weak fine granular structure, dry slightly hard, most friable, common roots, clear and smooth boundary.
B2.1	19 – 39 cm	Dark brown (10 YR 3/3), sandy clay loam, moderate fine and medium sub angular blocky, dry hard, moist firm, common roots, few fine hard concretions, gradual smooth boundary.
B2.2	39 – 60 cm	Dark brown (10 YR 3/3), sandy clay loam, moderate to weak, fine and medium sub angular blocky, dry hard, moist firm, fine to medium roots many, fine to medium hard and soft concretion, many gradual and smooth boundary.
B3	60 – 100 +cm	Dark brown (10 YR 3/3), gradually clay loam moderate, medium sub angular blocky, dry hard, moist firm, fine to medium roots many, fine to medium hard concretion many.

Profile No. 2. Compartment No. 505 (*A. auriculiformis*, *Gmelina arborea*, *Eucalyptus tereticornis* plantation)

<u>Horizon</u>	<u>Depth</u>	<u>Characteristics</u>
A1.1	0 – 19 cm	Dark yellowish brown (10 YR 4/4), sandy loam, weak fine granular structure, dry slightly hard, moist friable, fine roots many, clear and smooth boundary.
A1.2	19 – 37 cm	Dark yellowish brown (10 YR 4/6), sandy loam, weak fine granular structure, dry slightly hard, moist friable, fine root common, fine iron concretion common, gradual and smooth boundary.
B2.1	37 – 59 cm	Dark yellowish brown (10 YR 4/6), sandy clay loam, medium moderate sub angular blocky structure, dry hard, moist firm, few fine root, fine iron concretions many, gradual and smooth boundary.
B2.2	59 – 80 cm	Strong brown (7.5 YR 5/6), gravelly clay loam, medium moderate sub angular blocky structure, dry hard, moist firm, very few root, fine to medium iron concretion many, gradual and irregular boundary, cutans thin and patchy.
B3	80 – 105+cm	Brownish yellow (10 YR 6/6), gravelly clay loam, medium moderate sub angular blocky structure, dry hard, moist firm, few coarse root, fine to coarse iron concretion many, cutans thin and patchy, Quartzitic gravels common.

Study on elemental analysis of tree body parts

Elemental analysis of the samples collected from the mixed plantation of Balaghat were done for Nitrogen, Phosphorus, Potassium, Calcium, Magnesium and Sodium from different body parts viz. leaf, branch and stem of eight trees namely *Lagerstroemia parviflora*, *Gmelina arborea*, *Acacia catechu*, *Acacia auriculiformis*, *Emblia officinalis*, *Dendrocalamus strictus*, *Eucalyptus tereticornis* and *Cleistanthus collinus* in three compartments.

In a comparative tree study of quantification of percentage of elements in different plant body parts (Table 2), it was found that Nitrogen was in highest amount in *Emblia officinalis* leaf and lowest in *Acacia catechu* leaf; Phosphorus found highest in *Gmelina arborea* stem and lowest in *Lagerstroemia parviflora* branch; Potassium highest in *Emblia officinalis* leaf and lowest in *Acacia catechu* branch; Sodium highest in *Dendrocalamus*

strictus leaf while lowest in *Eucalyptus tereticornis* branch; Calcium highest in *Acacia catechu* leaf while lowest in *Acacia auriculiformis* stem; Magnesium highest in *Cleistanthus collinus* branch while lowest in *Acacia auriculiformis* branch (Figures 1 – 8).

Table 2. Elemental analysis of tree body parts collected from mixed plantation area at Balaghat

Species	Sample	Total N (%)	Total P (%)	Total K (%)	Total Na (%)	Total Ca (%)	Total Mg (%)
<i>L. parviflora</i>	Leaf	2.60	2.689	0.45	0.975	1.4	0.90
<i>L. parviflora</i>	Branch	0.96	0.707	0.495	0.260	2.2	0.42
<i>L. parviflora</i>	Stem	2.03	1.533	0.405	0.84	2.4	0.72
<i>G. arborea</i>	Leaf	3.26	2.594	0.72	0.930	3.1	0.90
<i>G. arborea</i>	Branch	1.36	1.368	0.585	0.86	1.6	1.02
<i>G. arborea</i>	Stem	1.06	2.924	0.45	0.905	2.0	0.96
<i>A. catechu</i>	Leaf	0.033	1.769	0.585	0.855	3.8	0.72
<i>A. catechu</i>	Branch	1.120	1.014	0.27	0.29	3.2	0.30
<i>A. catechu</i>	Stem	1.40	1.226	0.315	0.78	1.7	0.48
<i>E. officinalis</i>	Leaf	3.86	1.910	1.845	0.84	1.3	0.42
<i>E. officinalis</i>	Branch	1.63	2.075	0.63	0.94	2.8	0.30
<i>E. officinalis</i>	Stem	1.06	2.0518	0.72	0.83	1.8	0.84
<i>C. collinus</i>	Leaf	1.498	1.415	0.495	0.345	3.0	0.66
<i>C. collinus</i>	Branch	1.90	2.122	0.45	1.21	1.6	1.38
<i>C. collinus</i>	Stem	1.20	2.005	0.225	0.845	2.2	0.24
<i>D. strictus</i>	Leaf	1.20	1.344	0.63	1.35	2.2	0.36
<i>D. strictus</i>	Branch	1.06	1.439	0.45	0.825	1.3	0.66
<i>D. strictus</i>	Stem	0.366	0.9433	0.63	0.34	2.2	0.72
<i>A. auriculiformis</i>	Leaf	2.231	1.156	0.81	0.42	3.1	0.18
<i>A. auriculiformis</i>	Branch	0.932	0.7547	0.45	0.29	2.4	0.14
<i>A. auriculiformis</i>	Stem	1.06	1.25	0.225	0.910	1.2	0.48
<i>E. tereticornis</i>	Leaf	3.16	2.547	1.035	0.99	3.0	0.90
<i>E. tereticornis</i>	Branch	0.70	0.731	0.585	0.27	2.8	0.42
<i>E. tereticornis</i>	Stem	0.499	1.0613	0.72	0.325	2.9	0.30

Fig 1: Nutrient Content of *Lagers troemia parviflora*

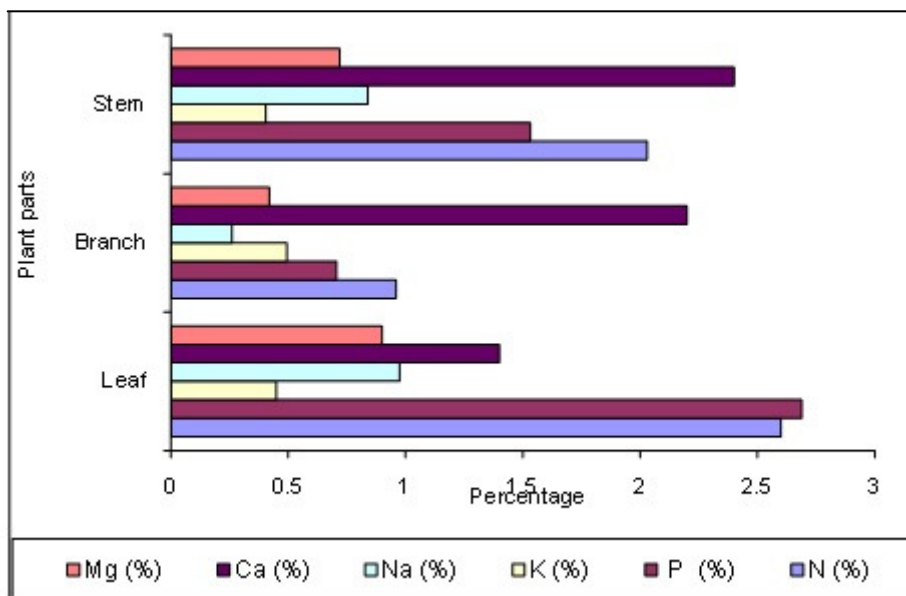


Fig 2: Nutrient Content of *Gmellina arborea*

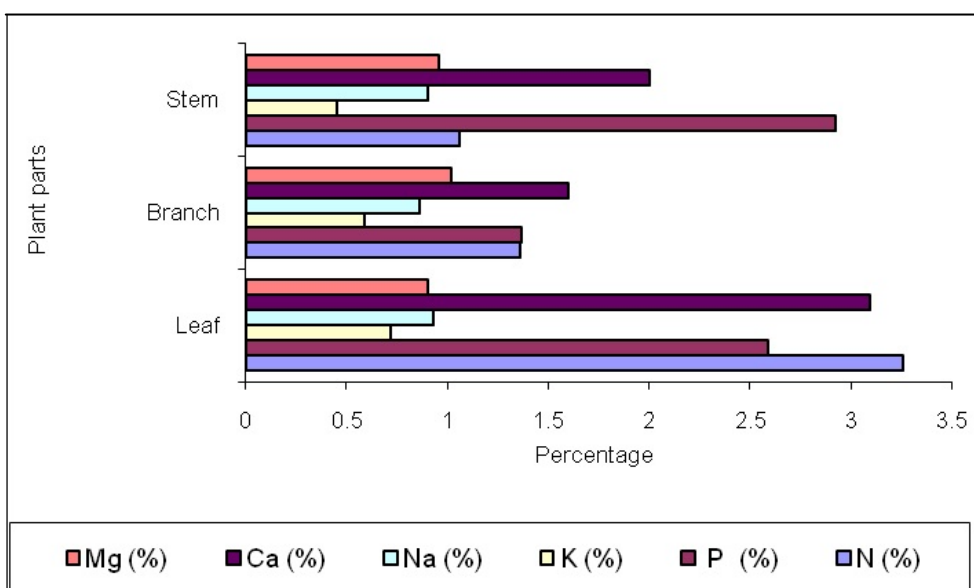


Fig 3: Nutrient Content of *Acacla catechu*

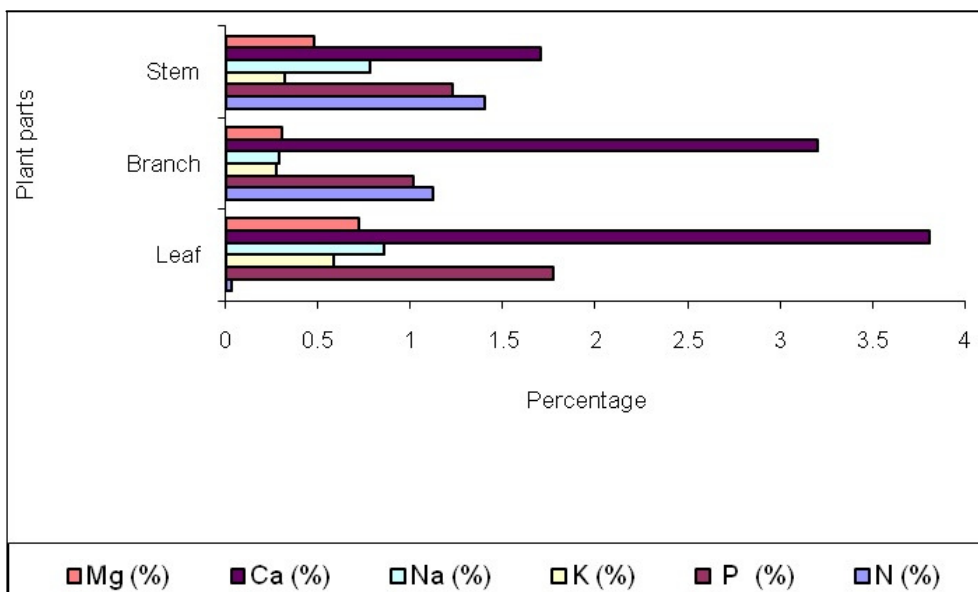


Fig 4: Nutrient Content of *Embilica officinalls*

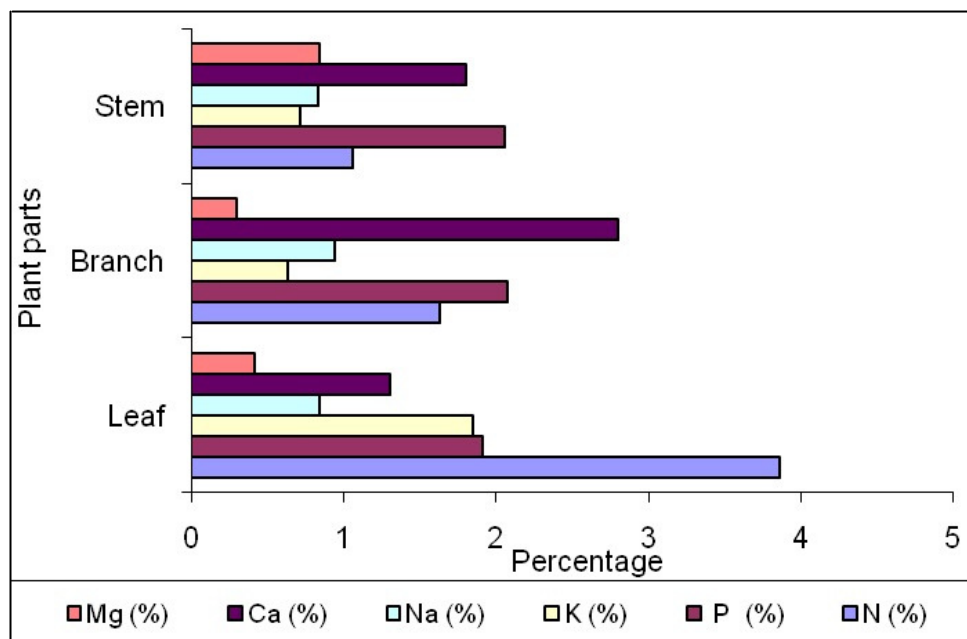


Fig 5: Nutrient Content of *Cleistanthus collinus*

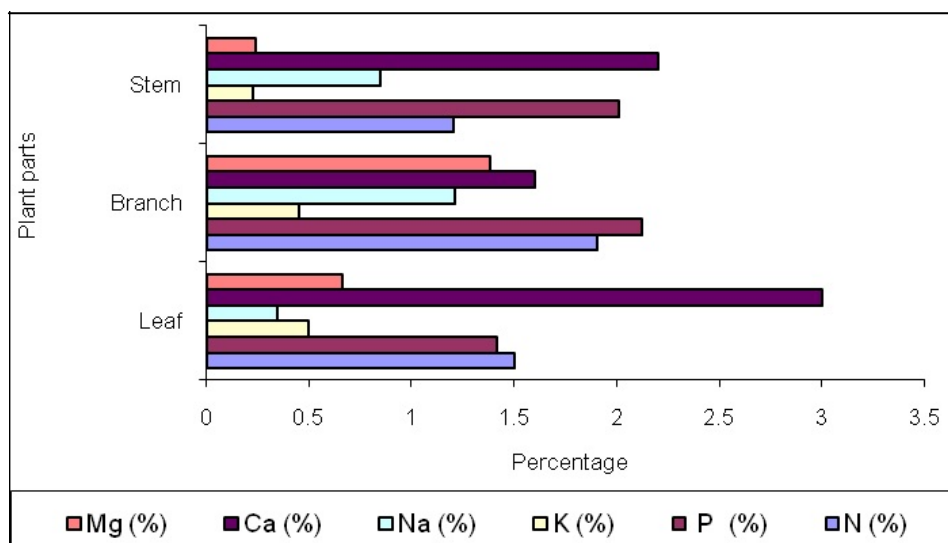


Fig 6: Nutrient Content of *Dendrocalamus strictus*

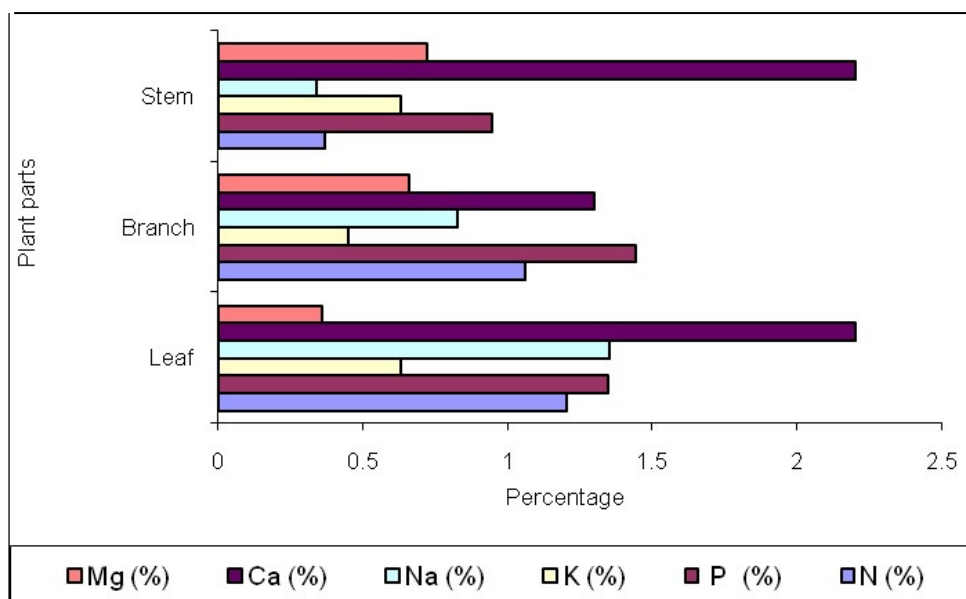


Fig 7: Nutrient Content of *Acacla auriculiformis*

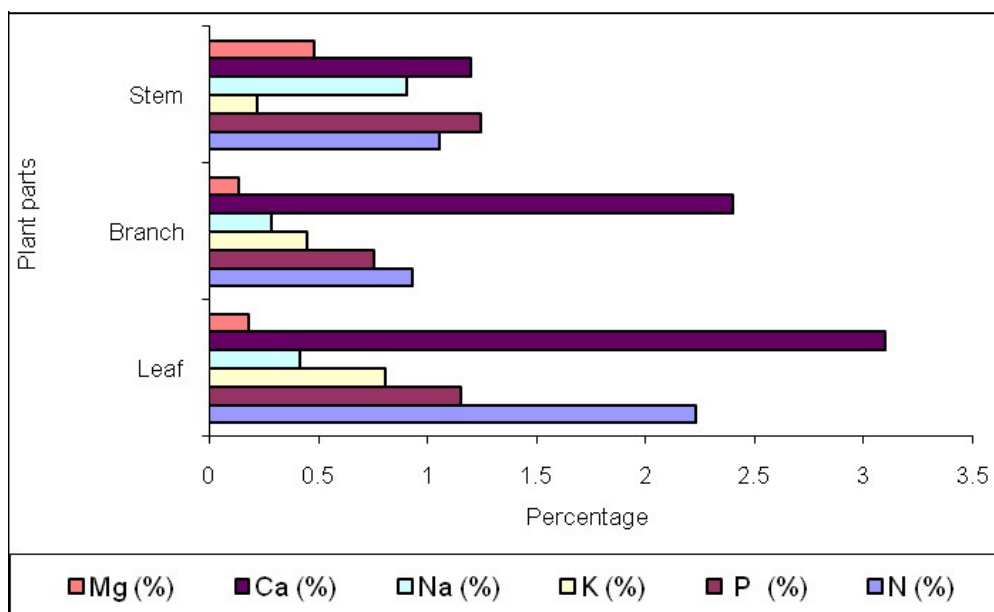
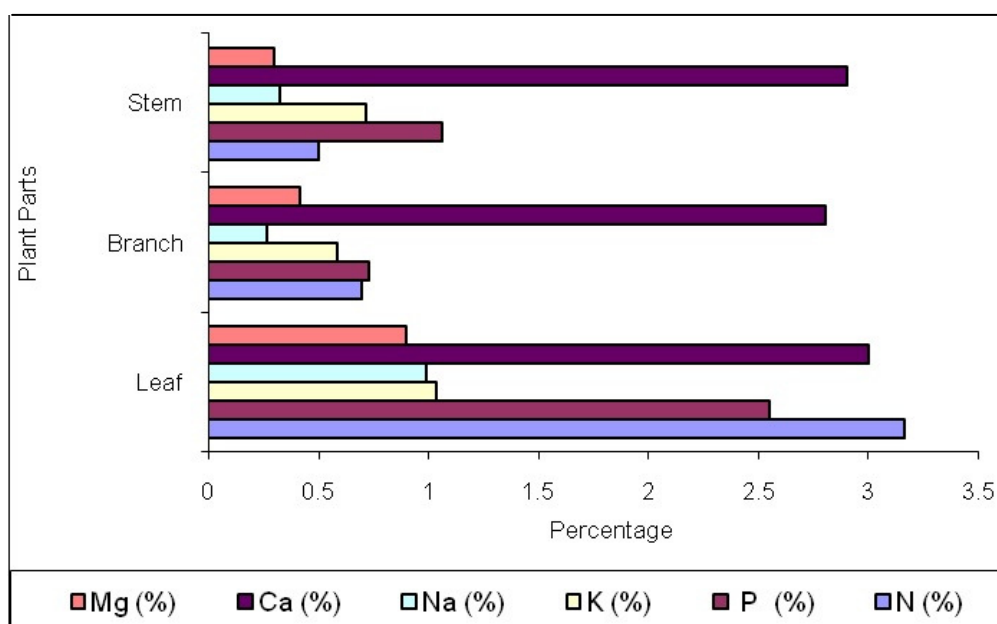


Fig 8: Nutrient Content of *Eucalyptus tereticornis*



Vegetation study

The vegetation study was done as described before; in compartment number 504, the important value index was found highest for *Dendrocalamus strictus* (85.11) followed by *Emblia officinalis* (49.74) and *Acacia catechu* (48.05); in compartment number 505, the important value index was found highest for *Acacia auriculiformis* (68.50) followed by *Gmelina arborea* (64.74) and *Eucalyptus tereticornis* (61.99); in compartment number 506, the important value index was found highest for *Lagerstroemia parviflora* (89.05) followed by *Cleistanthus collinus* (79.53) and *Butea monosperma* (35.76) (Tables 3, 4, and 5).

Table 3. 1990 Plantation; Balaghat - Compartment Number 504; Dominant Spp. – *Dendrocalamus strictus*, *Emblia officinalis* and *Acacia catechu*

	Q1	Q2	Q3	Avr.	C ² x 0.079	Total Plant No.	Total Basal Area	R. Dom	R. Den.	R. Freq.	IVI	Ni/N	Cd	H
TREE SPECIES														
<i>Dendrocalamus strictus</i>	150	125	110	128.3	1300.41	11	14304.5	66.57	6.54	12.00	85.11	0.283	0.082	0.357
<i>Emblia officinalis</i>	34	38	30	34.0	91.32	37	3378.8	15.72	22.02	12.00	49.74	0.165	0.027	0.297
<i>Acacia catechu</i>	18	24	20	20.6	33.52	48	1608.9	7.48	28.57	12.00	48.05	0.160	0.025	0.293
<i>Cleistanthus collinus</i>	15	20	27	20.0	33.52	13	435.7	2.02	7.73	12.00	21.75	0.072	0.005	0.189
<i>Saccopetalum tomentosa</i>	20	24	16	15.0	31.60	12	379.2	1.76	7.14	12.00	20.90	0.069	0.004	0.184
<i>Lagerstroemia parviflora</i>	15	18	12	23	17.77	19	337.6	1.57	11.30	12.00	24.87	0.082	0.006	0.205
<i>Terminalia chebula</i>	26	20	0	0	41.79	8	334.3	1.55	4.76	8.00	14.31	0.047	0.002	0.143
<i>Butea monosperma</i>	24	18	15	19.0	28.51	12	342.1	1.59	7.14	12.00	20.73	0.069	0.004	0.175
<i>Synzyium cumini</i>	0	26	22	24.0	45.50	8	364.0	1.69	4.76	8.00	14.45	0.048	0.002	0.145
Total Number of points of occurrence of species - 25						168	21485.1	99.95	99.96	100.00	300.01		0.157	1.997
SHRUB SPECIES														
<i>Corisa cingesta</i>	8	12	10	10.0	7.90	8	63.2	25.5	25.0	37.5	88.0	0.293	0.085	0.359
<i>Woodferdia floribunda</i>	7	8	8	7.6	4.56	9	41.0	16.5	28.1	37.5	82.1	0.273	0.074	0.354
<i>Holarrhina antidysentrica</i>	10	12	0	11.0	9.55	15	143.2	57.8	46.8	25.0	129.6	0.432	0.186	0.362
Total Number of points of occurrence of species - 8						32		99.8	99.90	100.00	299.7		0.345	1.075
HERB SPECIES														
<i>Eragrostis viscosa</i>	0.22	0.25	0.20	0.22	0.003	17	0.051	13.47	19.54	23.07	56.58	0.188	0.035	0.314
<i>Hemidesmus indicus</i>	0.32	0.30	0	0.31	0.007	16	0.112	30.68	18.39	15.38	64.45	0.214	0.045	0.329
<i>Heteropogon contortus</i>	0.27	0.25	0.30	0.27	0.005	12	0.060	16.43	13.79	23.07	53.29	0.177	0.031	0.306
<i>Casia tora</i>	0.29	0	0.30	0.29	0.006	20	0.120	32.87	22.98	15.38	71.23	0.237	0.056	0.341
<i>Cynodon dactylon</i>	0.12	0.15	0.10	0.12	0.001	22	0.022	6.02	25.28	23.07	54.37	0.181	0.032	0.309
Total Number of points of occurrence of species - 13						87	0.365	99.97	99.98	99.97	299.92		0.199	1.599

Q – Quadrate no. (Values of circumference in cm.) / C² x 0.079 - Constant / IVI – Important Value Index / Ni – Importance of value of individual species N – Total of all importance values / Cd – Coefficient of Dominance / H- Distribution index

Table 4. 1988 Plantation; Balaghat - Compartment Number 505; Dominant Spp. – *Eucalyptus*, *Gmelina arborea* and *Acacia auriculiformis*

	Q1	Q2	Q3	Avr.	C ² x 0.079	Ttl Plt No.	Total Basal Area	R. Dom	R. Den.	R. Freq.	IVI	Ni/N	Cd	H
TREE SPECIES														
<i>Eucalyptus</i>	25	22	27	24.6	47.80	47	2246.6	15.16	29.19	17.64	61.99	0.206	0.042	0.325
<i>Gmelina arborea</i>	22	26	30	26.0	53.40	48	2563.2	17.29	29.81	17.64	64.74	0.215	0.046	0.330
<i>Acacia auriculiformis</i>	40	38	35	37.6	111.68	37	4132.1	27.88	22.98	17.64	68.50	0.228	0.051	0.337
<i>Embllica officinalis</i>	22	26	30	26.0	53.40	18	961.2	6.48	11.18	17.64	35.30	0.117	0.013	0.251
<i>Dendrocalamus strictus</i>	105	110	85	100.0	790.0	6	4740	31.98	3.72	17.64	53.34	0.177	0.031	0.306
<i>Pongamia pinnata</i>	20	22	0	21.0	34.83	5	174.1	1.17	3.10	11.76	16.03	0.053	0.002	0.155
Total Number of points of occurrence of species – 17							14817.2	99.96	99.98	99.96	299.9		0.185	1.704
SHRUB SPECIES														
<i>Corisa congasta</i>	10	12	8	10.0	7.9	18	142.2	26.87	35.29	33.3	95.45	0.318	0.101	0.364
<i>Holarrihena antidysentrica</i>	12	16	10	12.6	12.54	21	326.3	61.67	41.17	33.3	136.14	0.454	0.206	0.358
<i>Lantana camara</i>	0	10	6	8.0	5.05	12	60.6	11.45	23.52	33.3	68.27	0.227	0.051	0.336
Total Number of points of occurrence of species – 9							529.1	99.99	99.98	99.90	299.86		0.358	1.058
HERB SPECIES														
<i>Heteropogon contortus</i>	0.27	.25	0	0.26	0.005	18	0.090	10.11	18.75	15.38	44.24	0.147	0.021	0.281
<i>Hyptis</i>	0.7	.80	.60	0.71	0.039	19	0.741	83.25	19.79	23.07	126.11	0.420	0.176	0.364
<i>Tridek procumbence</i>	0.15	.16	.15	0.15	0.001	20	0.020	2.24	20.83	23.07	46.14	0.153	0.023	0.287
<i>Cynodon dactylon</i>	0.12	.10	.12	0.11	0.001	24	0.024	2.69	25.00	23.07	50.76	0.169	0.028	0.300
<i>Eragrostis viscosa</i>	0.12	.10	0	0.11	0.001	15	0.015	1.68	15.62	15.38	32.68	0.108	0.011	0.240
Total Number of points of occurrence of species – 13						96	0.890	99.97	99.99	99.97	299.93		0.259	1.472

Q – Quadrant no. (Values of circumference in cm.) / C² x 0.079 - Constant / IVI – Important Value Index / Ni – Importance of value of individual species N – Total of all importance values / Cd – Coefficient of Dominance / H- Distribution index

Table 5. 1997 Plantation; Balaghat - Compartment Number 506; Dominant Spp. - *Lagerstroemia parviflora* and *Cleistanthus collinus*

	Q1	Q2	Q3	Avr.	C ² x 0.079	Total Plant No.	Total Basal Area	R. Dom	R. Den.	R. Freq.	IVI	Ni/N	Cd	H
TREE SPECIES														
<i>Lagerstroemia parviflora</i>	15	18	20	17.6	24.47	33	1296.9	40.56	32.71	15.78	89.05	0.296	0.087	0.360
<i>Diospyros melanoxylon</i>	12	10	8	10.0	7.90	19	150.1	4.69	11.72	15.78	32.19	0.107	0.011	0.239
<i>Madhuca indica</i>	10	12	0	11.0	9.55	5	47.7	1.49	3.08	10.52	15.09	0.050	0.002	0.149
<i>Butea monosperma</i>	16	20	22	19.3	29.42	13	38.24	11.96	8.02	15.78	35.76	0.119	0.014	0.253
<i>Terminalia tomentosa</i>	18	0	16	17.0	22.83	10	228.3	7.14	6.17	10.52	23.83	0.079	0.006	0.200
<i>Cleistanthus collinus</i>	15	18	14	15.7	19.47	52	1012.4	31.66	32.09	15.78	79.53	0.265	0.070	0.351
<i>Cassia fistula</i>	12	8	10	10.0	7.90	10	79.0	2.47	6.17	15.78	24.42	0.081	0.006	0.203
Total Number of points of occurrence of species - 19						162	3196.8	99.97	99.96	99.94	299.87		0.196	1.755
SHRUB SPECIES														
<i>Hollarina antidicentrica</i>	10	8	9	9.0	6.39	11	70.2	63.47	57.89	50.0	171.36	0.571	0.326	0.319
<i>Corisa congasta</i>	8	10	6	8.0	5.05	8	40.4	36.52	42.10	50.0	128.62	0.428	0.183	0.363
Total Number of points of occurrence of species - 6						19	110.6	99.99	99.99	100.0	299.28		0.509	0.682
HERB SPECIES														
<i>Heteropogon contortus</i>	0.3	0.5	0.2	0.3	0.007	18	0.126	13.74	23.37	25.00	62.11	0.207	0.042	0.326
<i>Hyptis sp.</i>	0.9	1.0	0.8	0.9	0.063	11	0.693	75.57	14.28	25.00	114.85	0.382	0.145	0.367
<i>Tridax procumbence</i>	0.17	0	0.18	0.17	0.002	20	0.040	4.36	25.97	16.66	46.99	0.156	0.024	0.289
<i>Cynodon sp.</i>	0.12	.15	0	0.13	0.001	18	0.018	1.96	23.37	16.66	41.99	0.139	0.019	0.274
<i>Casia tora</i>	0.26	.24	0	0.25	0.004	10	0.004	4.36	12.98	16.66	34.00	0.113	0.012	0.246
Total Number of points of occurrence of species - 12						77	0.917	99.99	99.97	99.98	299.94		0.242	1.502

Q – Quadrant no. (Values of circumference in cm.) / C² x 0.079 - Constant / IVI – Important Value Index / Ni – Importance of value of individual species N – Total of all importance values / Cd – Coefficient of Dominance / H- Distribution index

Biomass Study

With the permission and guidance from the State Forest Department, wet biomass was recorded as given in Table no. 6. It was noticed that in a plantation of almost 15 years, the height and collar girth increase most in *Cleistanthus collinus*; height grows least in *Lagerstroemia parviflora*, and burring the case of bamboos, collar girth grows least in *Eucalyptus tereticornis*. The wet weight increases most in *Emblia officinalis* while, except the case of bamboos, least in *Eucalyptus tereticornis*. All these observations might have important significance in further studies on mixed plantation areas.

Table 6. Wet biomass of tree species in mixed plantation of Balaghat

Tree species	Height (m-cm)	Collar girth (cm)	Year of plantation	Bole (kg-g)	Twig & Branch (kg-g)	Leaf (kg-g)	Total weight
<i>Dendrocalamus strictus</i>	8.10	11	1990	5.2	1.175	0.6	6.975
<i>Emblica officinalis</i>	7.25	20	1990	17.1	2.3	2.7	22.1
<i>Acacia catechu</i>	5.30	18	1990	9.2	2.	2.1	13.3
<i>Eucalyptus tereticornis</i>	5.50	15	1988	7.4	1.4	1.1	9.9
<i>Gmelina arborea</i>	5.45	20	1988	9.1	1.4	2.4	12.9
<i>Acacia auriculiformis</i>	6.30	17	1988	9.2	2.6	1.	12.8
<i>Cleistanthus collinus</i>	9.55	22	1990	13.	3.8	2.1	18.9
<i>Lagerstroemia parviflora</i>	4.10	18	1990	8.25	3.4	1.75	13.4

Data presented as average value of three samples.

Table 7. Physico-chemical characteristics of mixed plantation, Varseoni Range, Balaghat District, M.P.

Plantations	pH	E C	% Org. Carbon	Av. N kg/ha	Av. P kg/ha	Av. K kg/ha	CEC	Exch. K meq / 100g	Exch. Na meq / 100g	Exch. Ca meq / 100g	Exch. Mg meq / 100g	PBS
<i>D. strictus</i> (C504; 1990)	4.91	0.2	0.639	376.32	15.78	186.25	11.0	0.579	1.013	2.0	2.5	55.3
<i>E. officinalis</i> (C504; 1990)	5.40	0.2	0.772	423.36	13.15	372.70	13.1	0.528	0.834	3.3	2.8	56.9
<i>E. tereticornis</i> (C505; 1988)	4.83	0.2	0.549	313.60	18.41	296.25	10.6	0.623	0.809	2.2	1.2	45.5
<i>G. arborea</i> (C505; 1988)	5.20	0.2	0.824	423.00	18.41	226.25	13.6	0.640	0.712	2.8	2.2	46.6
<i>A. auriculiformis</i> (C505; 1988)	4.62	0.2	0.962	454.70	23.67	299.00	14.0	0.726	0.664	3.0	2.6	49.9
<i>C. collinus</i> (C506; 1997)	5.39	0.2	0.406	407.68	14.46	232.50	12.5	0.597	0.895	2.8	2.0	50.3
<i>L. parviflora</i> (C506; 1997)	4.67	0.2	0.707	564.00	30.24	226.25	14.0	0.660	0.804	3.2	2.6	51.8
<i>A. catechu</i> (C504; 1990)	5.03	0.2	0.729	470.40	9.20	300.00	13.5	0.579	0.812	3.2	2.8	54.7

Soil analysis study

The physico-chemical properties of soil samples are described in Table 7, and the significance has been discussed below.

Discussion

In general, the site of study on the mixed plantation is defined as Southern Dry Mixed Deciduous Forests 5A / C3 by Champion and Seth (1968). The principal geological formation is biotic gneiss, which is found in the plain area; somewhere it is exposed on the surface. Here the soil is drained, deep to very deep, gently sloppy to undulating upland. The soil varies from sandy loam to sandy clay loam texture and shows medium moderate sub-angular blocky structure.

Unlike the study in teak monoculture, correlating the soil nutrient status with that of plants is not easy as the litter is composed of decomposed leaves from all types' plants and trees. However, two soil profiles for compartment number 504 and 505 could be studied as stated before. The physico-chemical characteristics of the soil studied for the mixed plantation sites are given in Table 28. The pH of the soil in Compartment numbers 504, 505 and 506 are strongly acidic, and it varies from 4.62 to 5.40. The acidic nature of the soil is a result of formation from the acidic material of the existing parent rock.

The average nutrient concentration in compartment number 506 (Garari and Ledia plantation) shows slightly higher trend in the tune of 0.806% (organic matter), 485.8 kg/ha (average nitrogen) and 22.35 kg/ha (average phosphorus) respectively. The higher concentration of soil organic carbon, available nitrogen, available phosphorus and cation exchange capacity definitely play an important role to increase the fertility status of the soil.

In compartment numbers 504 (Bamboo, Aonla, Khair) and 505 (Eucalyptus, *Gmelina arborea*, *Acacia auriculiformis*), the nutrient variation is not much wider. The little difference in the three compartments is due to either for the difference in physiographic position or due to litter formation from the dominant and associated species. The nutrient status of the soil of these mixed plantation sites has increased considerably and this may be due to the impact of vegetation cover. The enrichment of nitrogen is not only due to the presence of large number of ground vegetation but also due to the addition of litter of mixed tree species. (Singh *et al*, 1987, Totey *et al*. 1988).

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